

Linear Elastic Model of an Explosion

Physical Model

- Sudden release of energy W
- Within a spherical cavity of radius r_c
- Causes an increase in pressure p_c .

Far Field Seismic Data

- Material properties ρ , α , β
- Scalar moment M_o
- Corner frequency f_c

Solution to the Inverse Problem

$$\text{Seismic energy} \quad E_s = \frac{\pi^2 M_o^2 f_c^3}{2\rho\beta\alpha^4}$$

$$\text{Explosion radius} \quad r_c = \frac{\beta}{\pi f_c}$$

$$\text{Explosion yield} \quad W = 2E_s$$

$$\text{Explosion pressure} \quad p_c = 2\rho\alpha^2 \frac{E_s}{M_o}$$

Test with NPE Explosion

Seismic Data

- $M_o = 2 \cdot 10^{14} Nm$
- $f_c = 3.3 Hz$

Inversion Results

Measured	Linear Estimate	Nonlinear Estimate
$r_c = 6.2 - 15.5 m$	$r_c = 116m$	$r_c = 15.5 m$
$W = 4.48 \cdot 10^{12} J$	$W = 1.36 \cdot 10^{11} J$	$W = 6.02 \cdot 10^{12} J$
$p_c = 1.8 GPa$	$p_c = 2.8 MPa$	